

REMARKS

Claims 1 through 37 are pending in this patent application. Claims 1 and 32 have been amended to more distinctively claim Applicant's invention, as suggested by the Examiner. Claim 3 has been cancelled.

Claim Rejections under 35 USC §102

Claims 1 and 4-5, 31 are rejected under 35 U.S. C. §102(e) as being anticipated by Hoof et al. (U.S. Patent 6,191,431). With respect to Claim 1, the Examiner stated that

Hoof et al teach a process of creating a broadly tunable distributed bragg reflector (DBR) structure with a low spontaneous recombination rate at operating temperatures comprising the steps of: creating a first cladding layer of a first conductivity type; creating an optical waveguide disposed on top of said first cladding layer comprising the steps of creating one or more hole confinement regions and creating one or more electron confinement region wherein the energy barriers of greater than the thermal energy, kT , separate adjacent confinement regions; creating a second cladding layer of a second conductivity type disposed on top of said optical waveguide. See Figs. 3 and 4, and claim 1.

Claim 1 has been amended to recite [a] process for creating a broadly tunable Distributed Bragg Reflector (DBR) structure with a low spontaneous recombination rate at operating temperatures comprising the steps of:

creating a first cladding layer of a first conductivity type;

creating an optical waveguide disposed on top of said first cladding layer comprising the steps of creating one or more hole confinement regions and creating one or more electron confinement regions wherein energy barriers of greater than the thermal energy, kT , separate adjacent confinement regions;

creating a second cladding layer of a second conductivity type disposed on top of said optical waveguide;

a conduction band energy barrier greater than the thermal energy, kT , is created by establishing an effective conduction band offset between adjacent confinement regions;

a valence band energy barrier greater than the thermal energy, kT , is created by establishing an effective valence band offset between adjacent confinement regions;

the band gap of said first cladding layer and the band gap of said second cladding layer are greater than the effective band gaps of said hole confinement regions;

the band gap of said first cladding layer and the band gap of said second cladding layer are greater than the effective band gaps of said electron confinement regions;

a first cladding layer conduction band energy barrier greater than the thermal energy, kT , is created by establishing an effective conduction band offset between the conduction band of said first cladding layer and the conduction band of the adjacent confinement layer;

a second cladding layer conduction band energy barrier greater than the thermal energy, kT , is created by establishing an effective conduction band offset between the conduction band of said second cladding layer and the conduction band of the adjacent confinement layer;

a first cladding layer valence band energy barrier greater than the thermal energy, kT , is created by establishing an effective valence band offset between the valence band of said first cladding layer and the valence band of the adjacent confinement layer; and

a second cladding layer valence band energy barrier greater than the thermal energy, kT , is created by establishing an effective valence band offset between the valence band of said second cladding layer and the valence band of the adjacent confinement layer.

Applicant has amended Claim 1 as suggested by the Examiner. Applicant agrees with the Examiner's assessment that prior art of record fails to teach the method of making a tunable DBR having the cladding layer valence and conduction bandgaps. It is respectfully submitted that Claim 1, as amended, is not anticipated by the cited reference of Hoof et al.

With respect to Claims 4-5, the Examiner stated that "Hoof et al. teaches n-type and p-type layers (Column 2, lines 1-35). Claims 4 and 5 are dependent on Claim 1 and are patentable over the cited reference of Hoof et al. for at least the same reasons described above for Claim 1.

With respect to Claim 31, the Examiner stated that "Hoof et al. teaches additional cladding layers (Fig. 2). Claim 31 is dependent on Claim 1 and is patentable over the cited reference of Hoof et al. for at least the same reasons described above for Claim 1.

Claim 32 has been rewritten in independent form that incorporates all of the limitations from Claim 1, as suggested by the Examiner. As amended, Claim 32 now recites a process for creating a broadly tunable Distributed Bragg Reflector (DBR) structure with a low spontaneous recombination rate at operating temperatures comprising the steps of:

- creating a first cladding layer of a first conductivity type;

- creating an optical waveguide disposed on top of said first cladding layer comprising the steps of creating one or more hole confinement regions and creating one or more electron confinement regions wherein energy barriers of greater than the thermal energy, kT , separate adjacent confinement regions; and

- creating a second cladding layer of a second conductivity type disposed on top of said optical waveguide;

- wherein said energy barriers are created by band gap tilting wherein:
said optical waveguide comprises a layer of graded material wherein the energy level of the lowest conduction band of said waveguide increases across the thickness of said waveguide, the energy level of the highest valence band of said waveguide increases across the thickness of said waveguide and the energy band gap of said waveguide varies across the thickness of said waveguide;

the changes in said energy levels creates an electron confinement region in said optical waveguide comprising a region wherein said energy level of the lowest conduction band and the adjacent cladding layer forms a local minimum in the conduction band:

the changes in said energy levels creates a hole confinement region in said optical waveguide comprising a region wherein said energy level of the highest valence band and the adjacent cladding layer forms a local maximum in the valence band:

the average band gap of said optical waveguide is greater than or equal to the carrier concentration in said optical waveguide divided by twice the thickness of said optical waveguide.

Applicant respectfully submits that the amended Claim 32 is not anticipated by the cited reference of Hoof et al.

Claim Rejections under 35 USC §103

Claim 2 is rejected under 35 U.S. C. §103 as being unpatentable over Hoof et al. as applied to claim 1 above, and further in view of Yamaguchi et al. The Examiner stated that "[w]hile Hoof et al. does not teach a grating layer, Yamaguchi et al. do (see Fig. 4, item 310). It would have been obvious to one of ordinary skill in the art at the time of the invention to add a grating layer, since as is well known in the art, the wavelength of the laser can be controlled by combining a certain grating wavelength with the index of refraction of the layer."

Claim 2 is dependent on Claim 1 and is patentable over the cited reference of Hoof et al. for at least the same reasons described above for Claim 1.

CONCLUSION

Claims 1, 2, and 4-37 are pending in this application. In view of the above, it is respectfully submitted by Applicant that the claims are in condition for allowance. Reconsideration of the rejections is requested. If the Examiner's action is other than allowance, the Examiner is requested to telephone Applicants' attorney at the number noted below.

Respectfully submitted,



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